B. NARROWBAND PCS

The personal communications services allocations for narrowband systems in the 900 MHz band will permit deployment of a wide range of "next generation" paging systems. By allowing carriers to obtain up to 300 kHz of spectrum, the Commission intended to foster a diverse variety of technical system designs. To date, proposals have included acknowledgement paging, two-way data massaging, as well as voice paging.

The FCC has allocated approximately 2 MHz of spectrum for 900 MHz narrowband PCS. This spectrum is located throughout the 901-902 MHz, 930-931 MHz, and 940-941 MHz bands, and is channelized into pairs of 50 kHz channels, 50 kHz channels paired with 12.5 kHz channels, unpaired 50 kHz channels, and unpaired 12.5 kHz channels for use with existing one-way massaging systems. These channels have been allocated for use on a national, regional (the FCC divided the country into 5 regions: Northeast, South, Midwest, Central and West), MTA, and BTA basis.

NARROWBAND PCS CHANNEL SUMMARY

Channel Type	No. Available	License Area
50 kHz/50 kHz	5	Nationwide
50 kHz/12.5 kHz	3	Nationwide
50 kHz unpaired	3	Nationwide
50 kHz/50 kHz	2	Regional
50 kHz/12.5 kHz	4	Regional
50 kHz/50 kHz	2	MTA
50 kHz/12.5 kHz	3	MTA
50 kHz unpaired	2	MTA
50 kHz/12.5 kHz	2	BTA

C. UNLICENSED PCS

Unlicensed personal communications services will make up an important part of the PCS offerings that will be available to the American public. Unlicensed PCS encompasses a diverse array of highly portable and mobile wireless data, voice, and messaging devices and systems that operate at low power. Studies have shown that there is a great demand for these products, which include personal digital assistants, laptop computers, wireless PBXs, wireless local area networks (LANs), improved cordless phones, portable facsimile machines, and a variety of other in-building or "on site" business and consumer-oriented applications. In addition,

unlicensed PCS products are expected to improve the nation's telecommunications infrastructure, afford new capabilities to consumers, expand the communications tools available to particular sectors (such as educators and health care professionals), increase business productivity, create employment opportunities, and ensure U.S. competitiveness in the global marketplace.

The Commission has allocated 20 MHz of spectrum at 1910-1930 MHz for unlicensed products. Asynchronous (mostly data) products were allocated the 1910-1920 MHz band. Isochronous (mostly voice) equipment was assigned 1920-1930 MHz.

TAB F

EXHIBIT 1

PCIA, APCO and NASNA Emergency Access Position Paper

August 1, 1994

PCIA, APCO and NASNA
Emergency Access
Position Paper

This paper presents a jointly developed position of PCIA, APCO and NASNA organizations to assist standards bodies in their development of appropriate standards for the implementation of access to emergency services from wireless communications systems via 9-1-1 type systems. It is the result of a joint analysis and an effort to resolve challenges to both the public safety as well as the wireless manufacturers and service provider communities. All participants in this effort have a desire to maximize the ability of using wireless access to facilitate rapid and effective contact with emergency services, when and where needed.

However, each group has a unique set of challenges to consider. The public safety organizations and their membership have an imbedded infrastructure base that they wish to guard against obsolescence. Wireless access implementations need to consider the ability to locate 9-1-1 callers and interwork with existing emergency service bureau systems, to guard against this obsolescence. The wireless manufacturers and service providers have economic and technological targets that must be met or new services such as Personal Communications Services (PCS) will, at best, be stymied or may never be launched.

The positions and requirements expounded here represent an effort to address the concerns of all participants. These recommendations (requirements) will be submitted as contributions

to the appropriate standards organizations for definition and adoption.

Introduction

This joint document has been prepared and is presented by the Personal Communications Industry Association (PCIA), the Association of Public Safety Communications Officials-International, Inc. (APCO) and the National Association of State Nine One One Administrators (NASNA). A description of each organization is contained in Appendix A.

Discussion

The basic 9-1-1 (9-1-1) and Enhanced 9-1-1 (E9-1-1) systems in existence today have been designed to provide rapid response to calls for emergency services from landline subscribers. Existing basic 9-1-1 emergency services systems establish routing of calls to a Public Safety Answering Point (PSAP). E9-1-1 provides added capabilities including selective routing of a call to the appropriate PSAP for quick response to emergency calls, display of calling number, address and, in most cases, the name of the subscriber at the calling number. However, these systems may not address the particular and unique requirements of wireless communications environments. Appendix B defines emergency service call taker information and feature priorities for both wireline and wireless systems.

The mobile nature of wireless services and the unique qualities of Radio Frequency (RF) propagation may require adaptation of

existing emergency services systems and development of special location capabilities in wireless systems.

Emergency services access (9-1-1/E9-1-1) in a wireless environment needs the capability to identify the location of the radio port or cell site (or sector if sectored) serving the calling party. This level of location identification will provide information to assist in routing the call to the proper PSAP and serve as a beginning point from which more precise user location capabilities can be developed, as technology and economics allow.

The wireless user may be reporting an emergency while mobile and may be some distance away from the emergency when the call is completed. The call-taker will still need to verify the caller's location. This situation exists today for the wireline 9-1-1 callers because they may be reporting from a location remote from the incident. Modifications to many of the existing emergency services systems will be necessary to provide both location and call back number.

New and developing wireless services, particularly PCS, will have new signaling platforms and protocols which might not be compatible with the existing information retrieval capabilities of the current emergency services systems. An additional challenge for interconnection of wireless telephone systems and emergency services systems will be to not substantially modify PSAP call taker procedures. The end user (PSAP call taker) processes should be similar to existing processes even though some infrastructure changes (such as signaling and data interfaces) may be necessary.

Requirements

Currently wireless systems communicate with a number of emergency service entities. These include basic 9-1-1 systems, enhanced 9-1-1 systems, police dispatchers, etc. The following requirements deal with wireless access to 9-1-1 - type systems. These requirements do not necessarily apply to wireless access to non-9-1-1 type systems.

1. 9-1-1 Availability

A user should have the ability to reach emergency services from any service initialized[1] wireless handset in a home service area or subscribed-to roamed service area by dialing the three digit number 9-1-1. No additional dialing digit sequence should be required to reach emergency services[2]. In addition, dialing 9-1-1 must override any lockout requirement for the handset or wireless terminal. Any handset that is service initialized on a wireless network must be allowed to make a 9-1-1 call, without a requirement for user validation.

2. Grade of Service

End to end grade of service objectives for wireless emergency access may involve several systems. Initiation of a wireless emergency access call will involve a wireless access system. Interconnection of the caller with a public safety call taker may involve interconnecting networks (e. g. PSTN) and termination of

[1] Service Initialized means that the owner has purchased services from a wireless service provider.

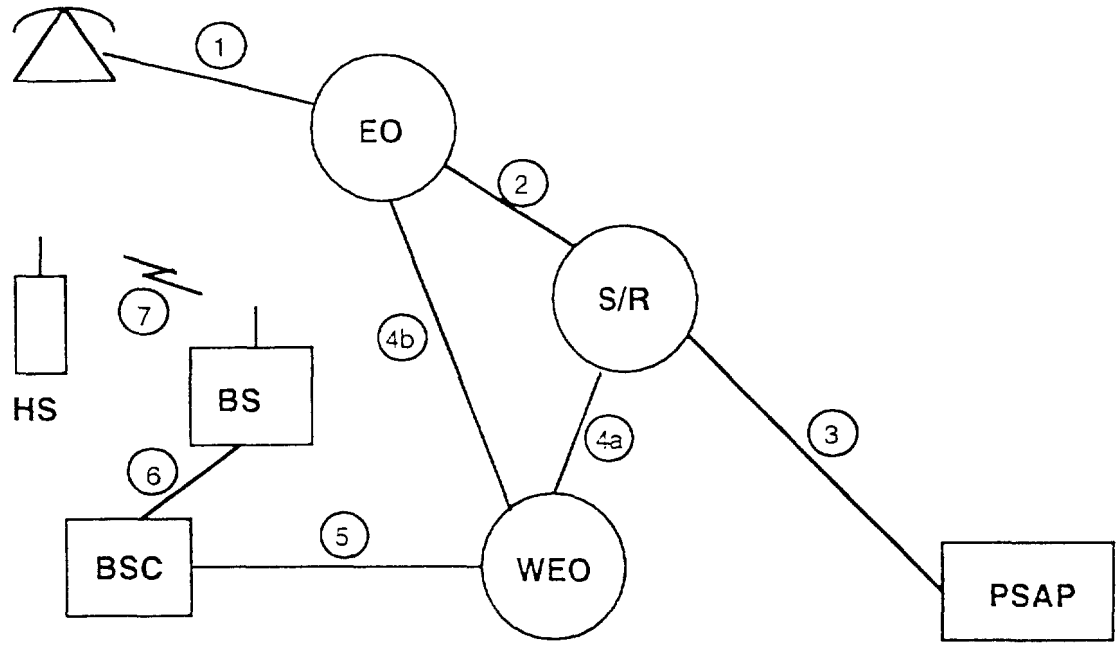
[2] This requirement does not preclude the implementation of an "emergency button" on the handset or the use of voice recognition to invoke the request for emergency access.

the call will involve the PSAP systems. Hence an overall grade of service objective, between a person in distress and a call taker, will require a cooperative effort between these initiation, interconnection, and termination systems. Proportioning grades of service within each system to reach overall objectives will need to be agreed upon locally and comply with appropriate local regulations.

Grades of service within each system will be established utilizing appropriate engineering and economic guidelines and are not areas subject for standardization.

Portions of the network used for emergency access may be the same for both wireline and wireless implementations. In some wireless implementations, a completely separate network may be used. In this instance, there could be a direct path from the wireless network to the Selective Router (S/R) or the PSAP. In other implementations, some portion of a LEC-based wireline network might be used to access the S/R or PSAP.

The following figure is an example of one network implementation and does not imply any particular ownership of the various network elements.



EO - end office (e.g., Class 5) **S/R** - selective router

HS - handset **BS** - base station

BSC - base station controller **WEO** - wireless end office

PSAP - public safety answering point

Link 1, between a wired telephone and an end office, is currently designed for a specified quality of service. This design is for minimum quality of service standard, and is typically specified by a State Public Utility Commission (PUC) and is not specifically designed for the requirements of emergency access. Links 7, 6 and 5 in a wireless system are analogous to link 1 in a wireline application, in that they are both the access path to an end office switch. Link 7 is

the radio path between the wireless terminal to the base station. Links 6 and 5 are generally designed to carry as much traffic as is generated over the radio links, in order to minimize call blocking. The driving force for the grade of service design for these links is the competitive environment in which wireless access services will exist. This necessity to compete in an area serviced by as many as 6 PCS, 2 cellular, 1 Enhanced Specialized Mobile Radio (ESMR) licensees and perhaps multiple local exchange carriers will prompt each service provider to maintain a grade of service high enough to keep customers (i.e., minimize blocking).

Links 2 and 3 however, may be interswitch trunks, whether dedicated or virtual, to emergency access and may be designed to a P.01 grade of service or to a grade of service negotiated and agreed upon by the 9-1-1 Delivery Provider[3] and the 9-1-1 Service Provider[4]. Implementations of links 4a/b should be designed to support the overall end to end grade of service objectives. These interswitch facilities could be used by either a wired or wireless access implementation.

A concern of this group is that the vagaries of marketing forces driving technical solutions may not, however, satisfy the emergency access and public use expectations.

Therefore, this group recommends that, for further consideration, the standards bodies developing radio standards investigate the feasibility of specifying technical solutions or strategies to minimize blocking of wireless 9-1-1 calls, from the radio

[3] Owner or provisioner of the S/R and the delivery facilities
[4] Owner or provisioner of the PSAP

system side of the network. Examples of issues to consider on the radio side might include load shedding, forced handoffs where existing calls can be maintained, etc. Issues for the public safety community to consider might include to use of advanced features such as Automatic Call Distribution (ACD) and Voice Response Units (VRU) to minimize blocking during overload conditions.

3. 9-1-1 Call Priority

An originating 9-1-1 call should have priority over other non-emergency services calls. This priority should extend to placing the 9-1-1 call at the beginning of a queue for calls waiting to be placed, if no radio or network resources are available. Because of the unknown nature or importance of calls in progress (i.e., a call to a suicide hotline or a poison control center), this priority requirement should not be interpreted to mean preempting or "bumping" a call in progress.

4. User Location Information

The wireless system should have the ability to identify the location of a wireless terminal used to make a 9-1-1 call. This location information shall be used to: (1) route a 9-1-1 call to the proper PSAP, based on the location of the base station to which that wireless handset is communicating and (2) provide the location of a terminal to the public safety call taker. Due to the concerns, both technical and financial, expressed by manufacturers and potential wireless service providers, a migration path for caller location is proposed. This migration path would start with a requirement for the location of the base station to which that wireless handset was

communicating and progress towards the ability to locate an individual wireless handset in a three-dimensional environment, as location technology and the cost of implementing such a technology become attainable. Technological advancements have indicated that the future may provide public safety with the ability to receive a high level of location accuracy from a wireless device.

It is the recommendation of this group that the standards bodies developing radio standards investigate the feasibility of specifying technical solutions or strategies to implement economically feasible detailed location capabilities at the call origination position and to make those capabilities available as soon as possible. Consideration should be given to both rural and urban environmental locational challenges and determine if a minimum geographic location accuracy within 400 feet could be achieved both technically and economically. A much higher level of location accuracy should be considered in urban environments where it will be necessary to determine the precise location of a caller within a multi-story structure.

5. Re-ring/Call back

The wireless system should have the ability of the emergency services call taker to reconnect, or call back the wireless handset if the call is disconnected or terminated prior to the finalization of the event. It should be noted that the group agreed that this requirement assumes the handset can receive the call back.

6. Information Elements Required in SS7 or ISDN-like Signaling

Future implementations of wireless systems and 9-1-1 type systems should be capable of providing a minimum number of information elements to the PSAP. The elements may include:

- Call back number and the handset subscriber's name
- Location of call origination, as discussed in section 4
- Class of service (e.g., residence, business, etc.)
- Wireless provider's name and telephone number
- Priority of the caller (e.g., hospital, school, etc.)
- Routing information to direct the call to the proper PSAP (Primary and Secondary PSAP identifiers)
- Transfer numbers - separate numbers to allow hot-key transfer of calls to police, fire and ambulance

7. Telephone Devices for the Deaf (TDD) Access

The wireless system should allow disabled individuals to access emergency services through means other than traditional wireless voice handsets (i.e., a TDD-like data device for the hearing impaired, etc.). To facilitate this requirement, there should be TDD-capable wireless devices but this does not impose a requirement that all wireless devices be TDD-capable.

It should be noted that new wireless systems will have a digital data capability. This capability will allow wireless users to communicate via data, without the use of traditional voiceband

facilities. This capability must be accommodated in the PSAP, in order to serve the widest universe of the public.

8. Future Requirements

This document raises the need for additional work on a number of details concerning requirements and needs for future emergency access. The FCC and standards bodies, among others, should develop or request the development of detailed requirements, cost analyses and possible solutions.

Appendix A

The Personal Communications Industry Association (PCIA), formerly Telocator, is a trade association representing more than 450 companies including PCS experimental licensees and entrepreneurs, paging, cellular, cable, manufacturing, computer, mobile data, SMR, local exchange and interexchange sectors of the industry.

Established in 1949, PCIA has been instrumental in advancing regulatory policies, legislation and technological standards that have helped make the communications revolution possible. One of PCIA's greatest strengths is its ability to foster and represent consensus in order to advance the interests of the wireless industry.

The Association of Public Safety Communications Officials-International, Inc. (APCO) is the world's oldest and largest not-for-profit professional organization dedicated to the enhancement of public safety communications. Members come from every type of public safety organization imaginable, from 9-1-1 centers and public safety departments which include police, fire, highway maintenance, corrections, forestry, emergency medical services and local government.

With more than 10,000 members worldwide, APCO International exists to serve the people who manage, operate, maintain and supply the communications systems used to safeguard the lives and property of citizens everywhere.

The National Association of State Nine One One Administrators (NASNA) is an organization of state officials whose purpose includes:

- Promoting information sharing amongst those states with programs dedicated to implementing 9-1-1 emergency telephone systems;
- Assisting other states with resolving issues necessary to accomplish statewide implementation and maintenance;
- Encouraging the establishment of a coordination person within each state or province;
- Identifying and recommending minimum standards for 9-1-1 emergency telephone systems;
- Identifying and recommending appropriate legislation or rules concerning the administration of statewide 9-1-1 emergency telephone system programs and;
- Serving as a knowledge resource for fulfilling the purposes described herein.

Appendix B

9-1-1 Call Taker Feature Priority

This appendix identifies 9-1-1 call features currently available to many emergency call taking organizations, listed in order of importance as defined by the APCO leadership. The availability of these features enables more timely arrival of public safety personnel, minimizing loss of life and property. The list is provided to promote a better understanding of call feature value as related to emergency response capability.

1. Ability to reach emergency services by dialing 9-1-1
2. Ability to permit call precedence for 9-1-1 over other call types
3. Ability to identify caller's geographic location
4. Ability to hear and determine the type of emergency services needed
5. Ability to receive 9-1-1 calls within their jurisdiction (Selective Routing)
6. Ability to detect and communicate with TDD and data callers
7. Ability to hold the line for trace, after the caller has disconnected (Called Party Hold), or the ability to call back.
8. Ability to call the caller back after disconnection and/or perform re-ring with the called party held
9. Ability to transfer the caller to the appropriate PSAP
10. Ability to transfer the information screen to the appropriate PSAP
11. Ability to force disconnect, regardless of the caller switch hook status

EXHIBIT 2

November 9, 1994

Dr. Robert J. Bonometti
Senior Policy Analyst
Executive Office of the President
Office of Science and Technology Policy
Old Executive Office Building
Washington DC 20500

Dear Bob:

It was a pleasure meeting with you on Friday, October 28th, to continue our dialogue on ways to speed the deployment and reduce obstacles to the rapid and economical roll out of new, Personal Communications Services (both narrowband and broadband).

As we discussed, there are several areas in which the executive branch can significantly contribute to the successful realization of PCS' full potential. These include:

1. **Establishing a uniform and consistent policy on deployment of PCS infrastructure.** The myriad of conflicting and inconsistent state and local regulations regarding the construction and operation of wireless telecommunications facilities threaten to undermine Federal goals of an increasingly competitive and robust commercial mobile radio service market and are contrary to the public's interest in a high quality, low cost, ubiquitous and spectrum-efficient wireless component to the National Information Infrastructure. The procedures and standards for constructing mobile radio towers and transmission facilities vary from locality to locality resulting in delays and increased cost of implementing effective, wide area communications networks. Some localities even prohibit new construction, an issue which has particularly negative ramifications for new licensees in broadband and narrowband PCS. National leadership, similar to that shown in the establishment of a comprehensive and uniform regulatory treatment of Commercial Mobile Radio Services in the *Omnibus Budget Reconciliation Act of 1993*, are needed in this area.

2. **Making Federal property available for siting of PCS facilities.** Federal property could, in many situations, provide prime locations for PCS base stations. Unfortunately, many agencies of the Federal Government are not willing to entertain such facilities because of perceived administrative burdens, lack of benefit to local agency staff or lack of clear policy or regulations for the leasing of Federal property for such an installation. A clear directive from the executive branch is required to overcome these obstacles. The benefits to the Federal Government include a substantial increase in the revenues from the installation of PCS networks above and beyond the auction proceeds, and improved communications on Federal property. Moreover, it would be a demonstration of leadership by the Federal government to tangible actions to implement the NII, and could encourage similar cooperation and participation by non-Federal entities.

3. **Establishing a uniform and consistent policy on access to and cost of sites on Federally-owned land.** Making sure Federal land resources continue to be available for efficient delivery of mobile communications services and ensuring that taxpayers receive a fair price from every communication company with transmitters on public lands are goals shared by industry, the Federal agencies and the public. Along with setting a clear directive that Federal land is to be used to accommodate PCS facilities, the executive branch needs to establish a clear set of policies and guidelines for implementing that directive. All of the Federal agencies that have private communications facilities on them have different regulations, lease documents and processes for doing so. These are often difficult, time consuming and expensive for both the agency and the communications companies. One clear, concise set of guidelines for locating the sites and establishing lease costs and documents is an absolute must to successful implementation of this directive. It will also overcome many of the objections of agencies which have been reluctant to entertain such facilities. The General Services Administration here in Washington has made great strides in this direction, and their policies and procedures might be the model to use for all Federal-owned land.

PCIA, in its more than four year commitment to new broadband and narrowband PCS, is currently actively pursuing a range of issues at the Federal Communications Commission and with the National Telecommunications and Information Agency which are absolutely critical to the successful deployment of these new services, once licensed. These include:

1. efforts to ensure adequate interconnection at reasonable prices (including availability of numbering resources) on an equal basis for all PCS providers;

2. successful implementation of the *Omnibus Budget Reconciliation Act of 1993* comprehensive and uniform framework for regulation of Commercial Mobile Radio Services, including the *Act*'s preemption of state rate and entry regulation;

3. coordination of PCS frequency use in areas adjacent to the Canadian and Mexican borders;

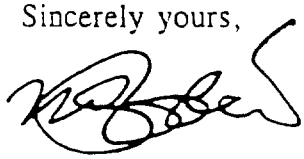
4. coordination of PCS frequency use with adjacent, government spectrum; and

5. emergency response (eg; E 911) plans for PCS.

The Administration's support and advocacy for this agenda before the FCC and within NTIA would materially advance the wireless component of NII policy.

PCIA looks forward to continuing to work with you on these critical issues.

Sincerely yours,



Mark J. Golden, CAE
Acting President

EXHIBIT 3

An overview of the standards development process

Development of Air Interface Standards for PCS

CHARLES I. COOK

For the past three-to-four years, Personal Communications Services (PCS) has been one of the hottest topics in the telecommunications industry. Of particular interest is the development of air interface standards. This article provides a concise overview of how standards developing organizations are approaching the task of PCS air interface standards development, a characterization of the air interface proposals, the current status of air interface standards development, and some generic projections.

PCS has generically been referred to as a concept that will make it possible to communicate with anyone — anytime — anywhere. This implies wireless, wireline, and networking capabilities. The FCC has defined PCS as "radio communications that encompass mobile and ancillary fixed communications that provide services to individuals and businesses and can be integrated with a variety of competing networks."[1] Furthermore, the FCC characterized PCS as encompassing "a broad range of new radio communication service that will free individuals from the limitations of the wireline public switched telephone network and will enable individuals to communicate when they are away from their home or office telephones."[2] The rapid growth of the cellular telephone industry, coupled with the government making additional spectra available, has made PCS one of the hottest, if not the hottest, telecommunications topic over the last three-to-four years.

Background

The prospect of PCS and the need to develop standards to facilitate PCS deployment, have attracted the attention of two major standards developing organizations: Committee T1 sponsored by the Alliance for Telecommunications Industry Solutions (ATIS) and the Telecommunications Industry Association (TIA) Engineering Committee TR45.

Committee T1 has traditionally dealt with developing standards and technical reports for the PSTN and ISDN wireline networks. Their work has included developing basic rate and primary rate ISDN, SS7, and SONET. TIA Engineering Committee TR45 has traditionally dealt with developing interim standards for wireless information networks and mobility management. Their work has included developing Advanced Mobile Phone Service (AMPS), Intersystem Signaling, and U.S. Digital Cellular. Committee T1 was interested in developing interfaces to support wireless access to the public network, and TIA was interested in developing wireless interfaces to the cellular network.

In 1990, a project proposal was introduced into Committee T1 which was approved in early 1991. The project proposal was "To define the Layer 1 interface specifications for wireless access to the public telephone and data networks, including the PSTN and ISDN...define specifications necessary for interoperability between the various wireless telecommunications systems (currently in operation and proposed for operation) and the wire line exchange and interexchange carriers...define those interface parameters for the various signaling and transmission segments making up the connecting elements between the mobile service user, mobile system provider, and the public telephone and data networks."[3] In December 1990, Committee T1 organized a new Technical SubCommittee (TSC), T1P1, to manage complex projects. PCS was identified as the first project to be addressed by T1P1.

In April of 1990, TIA established a "Microcell PCS" ad-hoc committee to "identify issues that are related to the establishment of Microcell PCS standards, and to recommend a course of action to the TIA MCD (Mobile Communications Division) regarding the standardization of Microcell PCS."[4]

Creation of the Joint Technical Committee on Wireless Access

It soon became obvious that both standards organizations were intent on developing wireless interfaces, and that there might be some synergies to working together. Furthermore, it was perceived that if the organizations worked together, the resulting products would be more likely to address the needs of the industry as a whole. Hence, a proposal was made to form a Joint Technical Committee (JTC) composed of the appropriate groups within TIA and Committee T1.

Actually forming the "JTC on Wireless Access" was easier said than done, and resulted in some growing pains on both sides in getting used to each other's modes of operation and agreeing on an appropriate set of working principles that would satisfy the procedural requirements of both organizations. To formalize the relationship, a Statement of Cooperation[5] was drafted and signed by Jesse Russell, chair of TIA Mobile Communications Division (MCD), and Art Reilly, chair of Committee T1.

to submit air interface proposals.

The JTC required that all interface proposals be brought to the table by November 1, 1993, one year after the JEM. At that time, 16 proposals were presented by 17 companies.

Based on the criteria, the JTC performed a constructive feedback exercise whereby the JTC provided comments on the proposals. These comments were recorded electronically and made available for analysis. The purpose of this exercise was to provide a feedback mechanism back to the proposers regarding the strengths and weaknesses of their proposals, and to provide an opportunity for them to strengthen their proposals accordingly.

When lab implementations of proposals become available, the JTC plans to conduct some testing, at the Boulder Industry Testbed, designed to maximize the amount of information that can be obtained in a one month testing period using a minimum amount of hardware.

A voluntary consolidation exercise was initiated that provided an opportunity for companies with similar proposals to attempt a voluntary compromise, or to voluntarily withdraw. This exercise resulted in reducing the overall number of proposals from sixteen down to seven.

In March 1994, technical ad-hoc groups (TAGs) were organized for each of the remaining proposals. Each TAG was charged with the responsibility to draft text appropriate for a Technical Report/Technical Service Bulletin (TR/TSB)[1] that sufficiently describes the technical details of a particular air interface technology so that manufacturers can begin the design process for product realization with minimal risk in those details undergoing significant change.

Upon completion of draft text, each TAG will re-address how well their respective proposals satisfy the JTC air interface criteria, and then conduct a validation and verification (V&V) process designed to editorially scrub and identify inconsistencies within the draft text prior to recommending the text for ballot.

Upon completion of V&V, a TAG may address whether additional modifications are needed to evolve the draft TR/TSB to a Standard, and make a recommendation regarding the proposed status of the document (i.e., TR/TSB/Standard). The JTC, by consensus, will then determine whether to recommend forwarding the document to the parent organizations for ballot and what status it should have.

Any comments received during the ballot process will be assigned to the JTC for resolution.

When lab implementations of proposals become available, the JTC plans to conduct some testing, at the Boulder Industry Testbed,[2] designed to maximize the amount of information that can be obtained in a one-month testing period, using a minimum amount of hardware. Such testing will facilitate relative comparisons between technologies that will verify the environments in which each technology is best suited, identify weaknesses that may need to be addressed, and provide an assessment of the feasibility of building equipment to comply with the respective [illegible] TR/TSB's Standard.

The Proposals

There are currently seven proposals under development. Table 1, taken from a presentation given at the National Engineering Consortium WPC Teleforum III [9], provides a brief summary of some of the technical characteristics of these interfaces.

To minimize political influences, the JTC has associated the activities of the TAGs with technologies rather than company proposals. The proposals can be characterized as follows:

TAG-1 (new): a composite 5 MHz CDMA/TDMA/FDMA air interface for large cell licensed-band applications, and small-cell, unlicensed-band applications. The basis of this proposal is derived from technology that resulted in the FCC awarding a "Pioneer's Preference" to Omnipoint Corporation.

The proposal supports a flexible structure of 32 8-kb/s timeslots capable of supporting up to 256-kb/s full duplex or 512-kb/s half duplex data rates through time slot aggregation. The proposal is advertised to be more cost effective because it takes advantage of the higher system capacities of CDMA, and does not require the use of equalizers. Since the proposal implements a Time Division Duplex (TDD) interface, service providers will not need to worry about clearing both uplink and downlink portions of spectrum of existing fixed microwave users before the system can be deployed.

TAG-2 (IS-95-based): a 1.25-MHz CDMA air interface for large cell applications. The basis of this proposal is derived from the 800-MHz Cellular EIA/TIA Interim Standard, IS-95.

The proposal provides an opportunity for interoperability between the 800-MHz cellular bands and the 1.8-GHz PCS bands. It supports variable rate speech coders that further increase the advertised capacity of CDMA systems. Soft handover is supported. The proposal also has hooks toward an evolution to an extended system that would have the potential to support higher data rates and ADPCM voice coders.

TAG-3 (Personal Access Communications System, or PACS): an eight-timeslot TDMA air interface with an FDD mode for small cell licensed-band applications and a TDD mode for small-cell, unlicensed-band applications. The basis of this proposal is derived from *Wireless Access Communications System (WACS)* developed by Bellcore, and *Personal Handy Phone* developed in Japan.

The design philosophy of the proposal is to develop a low-cost interface to address small-cell low-mobility applications. The proposal does not require equalizers. The proposal supports flexible timeslot aggregation, and flexible support of data services. The proposal will also support a TDD mode of operation in the unlicensed PCS band that is compliant with the spectrum etiquette.

TAG-4 (IS-54 based): a three-timeslot TDMA air interface for large-cell, licensed-band applications. The basis of this proposal is derived from the 800 MHz Cellular EIA/TIA Interim Standard, IS-54.

The proposal provides an opportunity for interoperability between the 800-MHz [illegible] and the 1.8-GHz PCS [illegible] speech coders [illegible] made or was [illegible]

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[1] *TR/TSB are terms used by Committee T1 and TIA, respectively, for roughly equivalent documents. These documents, although not ANSI standards, have sufficient status that manufacturers can build products to the requirements specified in them. If there is consensus these documents can be balloted as ANSI Standards.*

[2] *The Boulder Industry Testbed is a U S WEST [illegible] that has been made available, free of charge to the JTC for the purpose of conducting tests to facilitate development of air interface standards for PCS.*